What is claimed is:

1. A method of producing a silica dielectric film comprising
(a) preparing a composition comprising a silicon containing pre-polymer, optionally water, and optionally a metal-ion-free catalyst selected from the group consisting of onium compounds and nucleophiles;
(b) coating a substrate with the composition to form a film,
(c) crosslinking the composition to produce a gelled film, and
(d) heating the gelled film at a temperature of from about 750 °C to about 1000 °C and for a duration effective to remove substantially all organic moieties and to produce a substantially crack-free, and substantially void-free silica dielectric film.

2. The method of claim 1 wherein the composition of step (a) comprises water.

3. The method of claim 1 wherein the composition of step (a) comprises a metal-ion-free catalyst selected from the group consisting of onium compounds and nucleophiles.

4. The method of claim 1 wherein the resulting silica dielectric film has a density of from about 2 to about 2.3 g/milliliter.

5. The method of claim 1 wherein step (d) is conducted at a temperature of from about 900 °C to about 1000 °C.

6. The method of claim 1 wherein step (d) is conducted for from about 30 minutes to about 120 minutes.

7. The method of claim 1 wherein step (d) comprises heating the film at a temperature ranging from about 900 °C to about 1000 °C, for a time period ranging from about 45 minutes to about 75 minutes.

8. The method of claim 1 wherein the catalyst is selected from the group consisting of ammonium compounds, amines, phosphonium compounds and phosphine compounds.

9. The method of claim 1 wherein the catalyst is selected from the group consisting of tetraorganoammonium compounds and tetraorganophosphonium compounds.

10. The method of claim 1 wherein the catalyst is selected from the group consisting of tetramethylammonium acetate, tetramethylammonium hydroxide, tetrabutylammonium acetate, triphenylamine, trioctylamine, tridodecylamine, triethanolamine, tetramethylphosphonium acetate, tetramethylphosphonium hydroxide, triphenylphosphine, trimethylphosphine, trioctylphosphine, and combinations thereof.

11. The method of claim 1 wherein the composition further comprises a non-metallic, nucleophilic additive which accelerates the crosslinking of the composition.

12. The method of claim 1 wherein the composition further comprises a nucleophilic additive which accelerates the crosslinking of the composition, which is selected from the group consisting of dimethyl sulfone, dimethyl formamide, hexamethylphosphorous triamide, amines and combinations thereof.

13. The method of claim 1 wherein the composition comprises water in a molar ratio of water to Si ranging from about 0.1:1 to about 50:1.

14. The method of claim 1 wherein the composition comprises a silicon containing prepolymer of Formula I:

$$Rx - Si - Ly \qquad \text{(Formula I)}$$

wherein x is an integer ranging from 0 to about 2, and y is x-4, an integer ranging from about 2 to about 4;
R is independently selected from the group consisting of alkyl, aryl, hydrogen, alkylene, arylene, and combinations thereof;
L is an electronegative moiety, independently selected from the group consisting of alkoxy, carboxyl, acetoxy, amino, amido, halide, isocyanato and combinations thereof.

15. The method of claim 14 wherein the composition comprises a polymer formed by condensing a prepolymer according to Formula I, wherein the number average molecular weight of said polymer ranges from about 150 to about 300,000 amu.

16. The method of claim 1 wherein the composition comprises a silicon containing pre-polymer selected from the group consisting of an acetoxysilane, an ethoxysilane, a methoxysilane, and combinations thereof.

17. The method of claim 1 wherein the composition comprises a silicon containing pre-polymer selected from the group consisting of tetraacetoxysilane, a C_1 to about C_6 alkyl or aryl-triacetoxysilane, and combinations thereof.

18. The method of claim 16 wherein said triacetoxysilane is methyltriacetoxysilane.

19. The method of claim 1 wherein the composition comprises a silicon containing pre-polymer selected from the group consisting of tetrakis(2,2,2-trifluoroethoxy)silane, tetrakis(trifluoroacetoxy)silane, tetraisocyanatosilane, tris(2,2,2-trifluoroethoxy)methylsilane, tris(trifluoroacetoxy)methylsilane, methyltriisocyanatosilane and combinations thereof.

20. The method of claim 1 wherein the step (c) crosslinking is conducted at a temperature which is less than the heating temperature of step (d).

21. The method of claim 1 wherein the step (c) crosslinking comprises heating the film at a temperature ranging from about 100 °C to about 250 °C, for a time period ranging from about 30 seconds to about 10 minutes.

22. The method of claim 1 wherein the composition further comprises a solvent.

23. The method of claim 1 wherein the composition further comprises a solvent in an amount ranging from about 10 to about 95 percent by weight of the composition.

24. The method of claim 1 wherein the composition further comprises a solvent having a boiling point ranging from about 50 to about 250°C.

25. The method of claim 1 wherein the composition further comprises a solvent selected from the group consisting of hydrocarbons, esters, ethers, ketones, alcohols, amides and combinations thereof.

26. The method of claim 25 wherein the solvent is selected from the group consisting of di-n-butyl ether, anisole, acetone, 3-pentanone, 2-heptanone, ethyl acetate, n-propyl acetate, n-butyl acetate, ethyl lactate, ethanol, 2-propanol, dimethyl acetamide, propylene glycol methyl ether acetate, and combinations thereof.

27. A dielectric film produced on a substrate by the method of claim 1.

28. A semiconductor device comprising a dielectric film of claim 27.

29. The semiconductor device of claim 27 that is an integrated circuit.

30. A method of forming isolation structures in a semiconductor substrate comprising:

a) etching trenches in a semiconductor substrate, thereby forming substantially unetched areas of said substrate between said trenches;

b) depositing a conformal fill composition that substantially fills said trenches and to form a film, said composition comprising a silicon containing pre-polymer, optionally water, and optionally a metal-ion-free catalyst selected from the group consisting of onium compounds and nucleophiles;

(c) crosslinking the composition to produce a gelled film, and

(d) heating the gelled film at a temperature of from about 750 °C to about 1000 °C and for a duration effective to remove substantially all organic moieties and to

produce a substantially crack-free, and substantially void-free silica dielectric film.

e) optionally planarizing said silica dielectric film.

31. The method of claim 30 wherein step e) is conducted.

32. The method of claim 30 wherein step e) is conducted by polishing said silica dielectric film by chemical mechanical polishing.